

1. INTRODUCTION

The document contains the baseline DEP thermal control software requirements. It is based on a discussion among Roger Rehse, Jay Dusenbury, and Michael Levay and a follow-up discussion between Levay and Susan Bochner.

2. GENERAL DESCRIPTION

There are three thermal control systems that can be commanded from the DEP. The interface to the DEP is via an optically isolated 2 wire serial link. (data and clock). The electrical interfaces on the thermal side (i.e. away from the DEP) are very simple. Each contains a single register which serves as both the command interface to the DEP and the source of the control value for heaters. Jay has expressed some concern that these registers could be susceptible to noise and suggests as a general requirement that they be periodically reloaded by the DEP.

3. PRIME FILTER OVEN

3.1. DESCRIPTION

The Prime Filter Oven Controller is a closed loop system that operates at one of 8 programmable levels (3-bits). The system uses 10 thermistors, none of which is directly available to the DEP or the spacecraft, the determine an average oven temperature. The controller uses the difference between this average temperature from the commanded temperature to generate a voltage output to a set of heaters. The two the optics package thermistors that are on the Filter Oven (MTOPTS4 and MTOPTS5) are available to the DEP. The voltage output and the average temperature are also available to the DEP as the analogs named Loop Out and Bridge Out (mnemonics MUHPOLOP and MUHPOBRG). During normal operations, i.e. after the oven has stabilized, one would expect the MUHPOLOP to be about 10% away from the low (heater off) rail.

3.2. PROCESSING REQUIREMENTS

3.2.1. Control register

There is no direct feedback on the state of the control register. The DEP should send the most recent command to the controller once per minute.

THERMAL CONTROL SOFTWARE REQUIREMENTS

3.2.2. Oven Controller Monitoring

High temperature can damage the optics in the filter oven. To prevent this, the DEP must monitor the performance of the controller. If enabled to do so, the DEP will monitor MUHPOLOP. If this analog indicates the controller is operating on the high rail for more than a controllable number of one minute samples, the DEP will turn the prime oven controller power off.

3.2.3. Temperature Monitoring

The DEP will monitor the filter oven temperature. If the temperature exceeds a programmable value, power to the prime oven controller is switched off.

3.3. COMMAND REQUIREMENTS

The following table describes commanding requirements for the Prime Filter Oven Controller.

MNEMONIC	FUNCTION
MBHPOSPT	Prime Oven controller set point (0-7)
MBHPOMTW	Set the monitoring time window (minutes at rail before Oven Controller switched off)
MBHPOMON	Turn on Monitoring
MBHPOMOF	Turn off Monitoring
MBOVNMAX	Oven Maximum Temperature

3.4. TELEMETRY REQUIREMENTS

The following table defines the telemetry monitors directly associated with the Prime Filter Oven Controller in the context of this write-up.

MNEMONIC	TYPE	DESCRIPTION
MKPWHPO	D(1)	Prime oven heater power on/off.
MUHPOBRG	A	Filter Oven Bridge Out
MUHPOLOP	A	Filter Oven Loop Out
MTOPTS4	A	Optics Temperature 4 (Filter Oven)
MTOPTS5	A	Optics Temperature 5 (Filter Oven)
MKOVNMAX	D(8)	Filter Oven Maximum Temperature
MKHPOSPT	D(3)	Prime Oven Controller Set Point
MKHPOMON	D(1)	Prime Oven Monitoring On/Off
MKHPOMTW	D(4)	Prime Oven Monitoring Time Window (Minutes)

4. BACKUP FILTER OVEN

4.1. DESCRIPTION

The Backup Oven Heater Controller operates a set of heaters based on a (DEP) programmable voltage level. There is no hardware based closed loop control. The heater is simply operated at the commanded level. The DEP can read an analog representation of the programmed level, i.e. the output of a DAC.

4.2. PROCESSING REQUIREMENTS

4.2.1. Control Register Monitoring

The DEP will read back the heater level once per minute and verify the level is the same as the commanded level. The DEP will reissue the command as needed. If the control level is incorrect immediately after being commanded, the DEP will switch off power to the backup system.

4.2.2. Thermal Control

The DEP can control the temperature of the filter oven using the Backup Oven Controller. Once per minute, the DEP will monitor the oven temperature. If the oven temperature is within a programmable dead band, the DEP does nothing. If the temperature is outside the dead band but within the control band, the DEP will raise or lower the control voltage by one count. If the temperature is outside the control band, the DEP will set the voltage either full on or full off.

4.2.3. Temperature Monitoring

The DEP will monitor the filter oven temperature. If the temperature exceeds a programmable value, power to the backup oven controller is switched off.

4.3. COMMAND REQUIREMENTS

The following table describes commanding requirements for the Backup Filter Oven Controller.

MNEMONIC	FUNCTION
MBHROSPT	Backup Oven Controller Set point (0-255)
MBHROMDB	Backup Oven Controller dead band
MBHROMCB	Backup Oven Controller control band
MBHROMON	Turn on Monitoring
MBHROMOF	Turn off Monitoring
MBOVNMAX	Oven Maximum Temperature

4.4. TELEMETRY REQUIREMENTS

The following table defines the telemetry monitors directly associated with the Backup Filter Oven Controller in the context of this write-up.

MNEMONIC	TYPE	DESCRIPTION
MKPWHRO	D(1)	Backup Oven heater power on/off.
MTOPTS4	A	Optics Temperature 4 (Filter Oven)
MTOPTS5	A	Optics Temperature 5 (Filter Oven)
MKOVNMAX	D(8)	Filter Oven Maximum Temperature
MKHRODBH	D(8)	Backup Oven Controller Dead Band High
MKHRODBL	D(8)	Backup Oven Controller Dead Band Low
MKHROCBH	D(8)	Backup Oven Controller Control Band High
MKHROCBL	D(8)	Backup Oven Controller Control Band Low
MKHROMON	D(1)	Backup Oven Monitoring On/Off
MKHROSPT	D(8)	Backup Oven Controller Set Point (Commanded)
MKHROCPT	D(8)	Backup Oven Controller Control Point (Actual)

5. OPTICS PACKAGE STRUCTURE

5.1. DESCRIPTION

The Optics Package temperature is controlled by three sets of heaters. One of these is programmable to one of 64 levels. The other two are either on or off, the on state being equivalent power as the programmable set at its maximum level.

5.2. PROCESSING REQUIREMENTS

No processing is required for the monitoring or controlling the optics package temperature.

5.3. COMMAND REQUIREMENTS

The following table describes commanding requirements for the Optics Package Heater Controller.

MNEMONIC	FUNCTION
MBHOPSPT	Optics Package Controller set point (0-255)

5.4. TELEMETRY REQUIREMENTS

The following table defines the telemetry monitors directly associated with the Optics Package Heater Controller in the context of this write-up.

MNEMONIC	TYPE	DESCRIPTION
MKPWHOP	D(1)	Optics Package Heater power on/off.
MKHOPSPT	D(8)	Optics Package Controller Set Point

6. ENGINEERING MODEL REQUIREMENTS

There are no special requirements for the Engineering model other than its ability to recognize commands for the thermal control system and produce nominal telemetry.